Journal Pre-proof

Characterization of persons with reported SARS-CoV-2 infection in the Oklahoma City tri-county area: evidence from the first 12 months of transmission

Katrin Gaardbo Kuhn , Kapil Khadka , Kunle Adesigbin , Barbara Altidort , Kavya Boyina , Eddie Withers , Phil Maytubby , Aaron Wendelboe

PII: S0196-6553(22)00147-X
DOI: https://doi.org/10.1016/j.ajic.2022.03.007
Reference: YMIC 6185

To appear in: *AJIC: American Journal of Infection Control*

Please cite this article as: Katrin Gaardbo Kuhn , Kapil Khadka , Kunle Adesigbin , Barbara Altidort , Kavya Boyina , Eddie Withers , Phil Maytubby , Aaron Wendelboe , Characterization of persons with reported SARS-CoV-2 infection in the Oklahoma City tri-county area: evidence from the first 12 months of transmission, *AJIC: American Journal of Infection Control* (2022), doi: https://doi.org/10.1016/j.ajic.2022.03.007

Major Article | Major Article

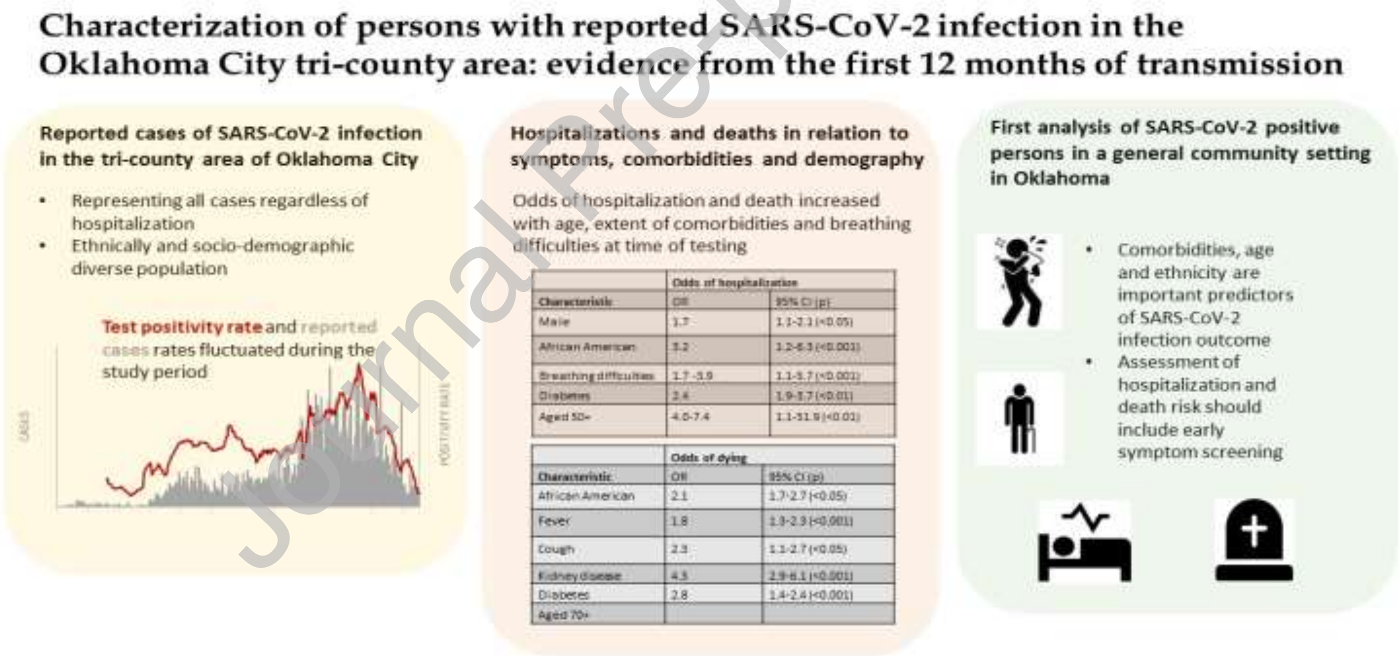
Characterization of persons with reported SARS-CoV-2 infection in the Oklahoma City tri-county area: evidence from the first 12 months of transmission

Katrin Gaardbo Kuhn[1,*] katrin-kuhn@ouhsc.edu, Kapil Khadka[2], Kunle Adesigbin[2], Barbara Altidort[2], Kavya Boyina[1], Eddie Withers[2], Phil Maytubby[2], Aaron Wendelboe[1]

[1]Department of Biostatistics & Epidemiology, Hudson College of Public Health, Department of Biostatistics & Epidemiology, Oklahoma University Health Sciences Center, 801 NE 13th St, Oklahoma City, Oklahoma
[2]Oklahoma City-County Health Department, 2600 NE 63rd St, Oklahoma City, Oklahoma
[*]Corresponding author.

The authors have no conflicts of interest to Declare.

Graphical Abstract



Abstract

Objectives. To describe characteristics, hospitalization and death for reported cases of SARS-CoV-2 infection in the Oklahoma City tri-county area.

Methods. We extracted notified cases of SARS-CoV-2 infection for our study area and used descriptive statistics and modeling to examine case characteristics and calculate the odds of hospitalization and death in relation to a range of explanatory variables.

Results. Between March 12th, 2020 and February 28th, 2021, 124,925 cases of SARS-CoV-2 infection were reported from the study region. Being male, White or Black/African American, aged 50 years or older, presenting with apnea, cough and shortness of breath and having diabetes was associated with increased odds of hospitalization. The odds of dying were significantly associated with being Black/African American, presenting with cough and fever, having kidney disease and diabetes and being aged 70 years or older.

Conclusions. The first cohort analysis of SARS-CoV-2 positive individuals in the Oklahoma City tri-county area confirms comorbidities and age as important predictors of COVID-19 hospitalization or death. As a novel aspect, we show that early symptoms of breathing difficulties in particular are associated with hospitalization and death. Initial case assessment and SARS-CoV-2 guidelines should continue to focus on age, comorbidities, and early symptoms.

Keywords

COVID; SARS-CoV-2; Oklahoma City; demography; hospitalization; death; comorbidities; symptoms

Introduction

Since the start of the COVID-19 pandemic in early 2020, the United States has experienced the highest rate of reported positive cases of SARS-CoV-2 infection and related deaths (1). Throughout 2020 and 2021, the pandemic has been studied in great detail with respect to many different epidemiological facts including risks for age and gender, ethnicity and comorbidities in the population (2–4). The majority of these studies were based on data from large cities or selected population groups such as veterans, hospitalized patients or specific ethnic groups. Only a limited number of publications have used routinely collected surveillance data from smaller urban areas focusing on both hospitalized and non-hospitalized SARS-CoV-2 positive individuals (2,5–11). In general, published evidence suggests that males are more likely to be infected, hospitalized and die from severe COVID-19 than females (12,13). It has also been shown that persons with certain types of comorbidities and persons older than 70 years of age have a higher risk of infection, hospitalization and death compared to healthier, younger patients (14). Finally, several studies have concluded that certain ethnic minorities are disproportionately affected by infection and disease (3,10,15).

Oklahoma is located in the South-Central US Great Plains and has a population of approximately 4 million. The first case of SARS-CoV-2 infection was reported in the State on March 6th 2020, with continued high levels of transmission and increasing rates of hospitalizations throughout the year (16). Oklahoma has a diverse population with many ethnic and rural communities that are known to be particularly vulnerable to the SARS-CoV-2 infection, COVID-19 disease and severe outcomes. Oklahoma City is the State Capital, with an estimated population of 681,000 persons in 2021 (17). The city demographics are relatively diverse with 53% of the population reported as White Non-Hispanic origin, 21% Hispanic, 14% Non-Hispanic Black and 3% American Indian and Alaskan Native in 2019. No state-wide mask mandate was issued during the pandemic, however a number of counties and cities, including Oklahoma City and surrounding counties, adopted mask mandates. Furthermore, state-wide restrictions such as business closures, limits to gatherings, indoor sports closures and sanitation requirements were also implemented to limit the spread of COVID-19.

This work presents a thorough analysis of reported COVID-19 cases in the tri-county region of Oklahoma City. The aim of the study is to describe persons from the tri-county area of Oklahoma City who had a confirmed positive SARS-CoV-2 test, in order to understand how certain patient characteristics were related to hospitalization and death and to suggest evidence-based guidelines for assessment of SARS-CoV-2 positive individuals.

Materials and Methods

In this retrospective observational cohort study, we extracted notified COVID-19 cases (SARS-CoV-2 infection) from March 12th, 2020 until February 28th 2021 for the tri-county region (Oklahoma, Cleveland and Canadian counties) from Oklahoma State Department of Health (OSDH) surveillance data through the Public Health Disease Detection of Oklahoma (PHIDDO) reporting system. Providers and laboratories report confirmed and probable COVID-19 cases to PHIDDO following a diagnosis. Provided that sufficient resources are available, case investigators at County Health Departments interview cases in their respective counties and update PHIDDO with additional information. PHIDDO data is synced daily to an SQL server maintained by OSDH. A COVID-19 case is diagnosed through a molecular (e.g., RT-PCR, NAAT, LAMP) or antigen (e.g., rapid test) test from a sample collected by way of saliva, throat or nose swab.

For each confirmed case, we extracted the following: (1) date of notification in the system, (2) symptom onset date, (3) age, (4) gender, (5) ethnic group, (6) location (county, city/town, and zip code), (7) occupation, (8) presence of various symptoms at the time of testing, (9) information on chronic comorbidities and (10) whether the person was hospitalized and/or died following their diagnosis. All data on symptom onset, presence of symptoms, and presence of comorbidities were self-reported by the patient and covered symptoms/comorbidities as defined in a simple questionnaire without ICD codes. Patients were also asked to self-identify their ethnicity, gender and occupation. Data on hospitalizations and deaths reflect hospitalizations and deaths specifically due to COVID-19, with COVID-19 listed as the main cause on hospital admission records and death certificates, respectively. We extracted daily numbers of administered and positive PCR tests for SARS-CoV-2 infection for the State of Oklahoma from the COVID Tracking Project website (18). Patients with 'no information provided' for specific variables (e.g. symptoms or comorbidities) were excluded from the analyses for that particular variable. The number of persons excluded from the analysis for each explanatory variable is listed in Table 1 where possible. All data were analyzed using basic descriptive statistics and univariate and multivariate logistic regression. Multivariate regression models were adjusted for the confounding effect of gender, age, county of residence, ethnicity, and presence of comorbidities. We also adjusted multivariate models for interactions between these confounders. A backwards variable selection approach was employed.

Data analyses were performed in STATA 17.0 (StataCorp 2019, College Station, TX). The study was declared exempt from IRB oversight.

Results

Case trends and demography

Between March 12th, 2020 and February 28th, 2021, a total of 124,925 cases of SARS-CoV-2 infection were reported from the study region (Table 1, Figure 1). Of these, 80,540 (64.5%) of cases were reported from Oklahoma county (the most populous) followed by Cleveland (22.8%) and Canadian (12.7%) counties.

We observed limited transmission in the early pandemic phase from March to June 2020. This was followed by a substantial increase in cases at the end of June 2020 and the largest increase in disease transmission in November – December 2020, accounting for 44% all cases during the study period. (Figure 1). From early January through February, 2021, there was a notable decrease in reported cases and the number of SARS-CoV-2 positive tests in the State as a whole (Figure 1).

The average age of the reported cases was 38.8 years (median 37 years) ranging from 1 month to 102 years (Table 1). The highest proportion of infections was diagnosed among young adults aged 18 - 29 years with 23.9% of reported cases, persons aged 30-39 years (17.5%) and the 40-49-year group (15.3%) (Table 1). People identifying as White had the highest number of cases (36.7%), followed by Hispanic or Latino (12.5%) and African American or Black (8.8%).

Hospitalizations and deaths

A total of 4,076 (3.2%) persons with a confirmed SARS-CoV-2 infection in the tri-county Oklahoma City area were hospitalized and 1,858 (1.5%) died. The highest percentage of hospitalizations was observed among the White ethnic group (66.6%) and Black/African Americans (15.1%). This mirrored the results for deaths where 66.9% of reported deaths were among White persons and 9.9% among Black/African Americans. Compared to the average hospitalization and death rates during the study period, we observed initial high rates from March until end of June 2020, ranging between 20 – 50% (Figure 2). After this point, both hospitalization and death rates stabilized at 4-10% for hospitalizations and 1-3% for deaths, remaining at those levels until the end of the study period (Figure 2).

The average age of hospitalized patients was 63 years (median 65), ranging from zero to 102 years. Being 30 years or older was associated with significantly higher odds of hospitalization and this generally increased with age, apart from persons aged older than 90 years (Table 1). The average age of persons who died from COVID-19 was 74 years (median 76), ranging from 2 to 108 years old. The odds of dying increased with age, reaching a peak for persons aged 80-89 years (Table 1). Compared to White persons, Black or African Americans had the highest odds of being hospitalized and dying, followed by American Indians or Alaskan Natives (Table 1).

Comorbidities and symptoms

A total of 37,482 (30%) persons with a reported positive SARS-CoV-2 test indicated having at least one comorbidity; the most common of which were cardiovascular disease (5.5%), diabetes (4.1%) and lung disease (4.1%) (Table 1). Having any comorbidity, apart from liver disease, was associated with higher odds for hospitalization. This was most pronounced for cardiovascular disease and diabetes (Table 1). Persons with any type of comorbidity had higher odds of dying, particularly if they had kidney or cardiovascular disease (Table 1). The odds of dying increased with the number of comorbidities, and patients with four or five comorbidities had approximately six times higher odds of dying compared to patients with two comorbidities (Table 1).

A total of 73,603 (58.9%) persons reported that they did not experience any symptoms in relation to their infection and were classified as 'asymptomatic'. The most common symptoms reported were malaise/myalgia, fever/chills, gastrointestinal complaints, headache and cough (Table 1). Most symptoms recorded were associated with a higher risk of hospitalization, in particular breathing difficulties, malaise/myalgia, fever/chills and cough (Table 1). The more symptoms recorded by a patient, the higher the odds of hospitalization. Several symptoms were also associated with increased odds of dying; the most significant being breathing difficulties, cough and fever/chills (Table 1). There was no significant relationship between the number of symptoms and the odds of dying.

Lifestyle and Occupation

Of the study population, a total of 8.4% (10,485 persons) reported currently smoking or having smoked previously. Being a current or previous smoker was significantly associated with an increased risk of both hospitalization and death (Table 1).

Data on occupation were available for 41,766 (33.4%) of the reported cases. Of these, 19,847 (47.5%) provided specific details on the type of their occupation. The most frequently reported were retired (17.3%), unemployed (12.1%) and healthcare worker (12.0%). There was no significantly increased or decreased odds of hospitalization associated with type of occupation

(Table 1). However, persons who were retired or worked as teachers had increased odds of dying while university students had reduced odds of death (Table 1).

Multivariate analyses

Being male, White or Black/African American, aged 50 years or older, having diabetes and presenting with breathing difficulties and cough was associated with increased odds of hospitalization (Table 2). Increased odds of death was significantly associated with being Black/African American, presenting with cough and fever/chills, having kidney disease and diabetes and being aged 70 years or older (Table 2).

Discussion

In this paper we describe the characteristics of persons who tested positive for SARS-CoV-2 infection during the first 12 months of transmission in the tri-county area of Oklahoma City, including individuals who were later hospitalized and died from COVID-19.

Of the almost 125,000 persons who tested positive, approximately 3% were hospitalized and 1.5% died from their infection. In our study population, the odds of hospitalization and death increased significantly with age, confirming several previous findings that COVID-19 has the strongest impact on elderly persons (9,15,19). Our results also confirm that existing comorbidities – particularly cardiovascular disease and diabetes - significantly increase the risk of developing severe disease, becoming hospitalized and dying (3,8,9,20). In our study population, persons who suffered from several comorbidities had increasing odds of both hospitalization and death.

Although the role of comorbidities in relation to COVID-19 severity is relatively well understood, non-chronic symptomatic presentations at the time of testing have primarily been studied in relation to biomarkers and prognostic factors (21–23) rather than examining the association initial symptoms and later hospitalization or death. Our study demonstrates some

of the first population-derived results on symptoms in a cohort of SARS-CoV-2 positive individuals, regardless of hospitalization status. Firstly, almost 60% of the persons included in our study reported that they were asymptomatic. This is in line with other published findings and confirms that asymptomatic status is common for persons with confirmed infection (24). Secondly, presenting with cough, general breathing difficulties, and fever/chills at the time of testing was generally associated with increased odds of both hospitalization and death. We also observed a dose-response relationship between the number of symptoms and the odds of hospitalization, but not of dying. This could suggest that the progression from hospitalization/disease to death is primarily affected by other factors such as comorbidities. Interestingly, only a small proportion of persons in our study reported loss of taste and smell, even though this symptom has been highlighted as one of the primary indicators of SARS-CoV-2 infection (25). However, considering that this symptom was only reportable as a free-text option, rather than a yes/no like the other symptoms examined, this result may not accurately reflect the true frequency of loss of taste and smell in the study cohort.
Our multivariate modeling indicated that higher odds of hospitalization were significantly related to ethnicity (being White or African American/Black), having diabetes, experiencing breathing difficulties at time of testing, and being aged 50 years or older. Dying from COVID-19 was associated with being Black/African American, having diabetes and kidney disease, experiencing cough and fever at time of testing and being aged 70 years or older.

SARS-CoV-2 infection and COVID-19 disease is known to disproportionately affect certain ethnic groups such as Hispanics or Latinos and African Americans (6,10,26). We confirm this with our results showing that African American/Black persons with a positive SARS-CoV-2 test had approximately 3 times higher odds of hospitalization and 1.4 higher odds of dying compared to Non-Hispanic White persons. A similar scenario, although only for death, was observed for Hispanic/Latinos in our study who had significantly higher odds of dying.

Our findings need to be considered in the light of several limitations. Firstly, all symptoms and existing comorbidities were self-reported by each patient, and it was not possible to confirm this information by screening of individual records. Overall, this is an important limitation of the study; however, we also consider the general possibility of each patient inaccurately reporting chronic conditions to be low. With respect to symptoms and comorbidities, these were not recorded in the questionnaire using standardized ICD codes and as such are subject to individual reporting and interpretation biases. For instance, the extent to which 'cardiac disease' includes hypertension is unknown, because this condition was reported at the discretion of the patient. Similarly, we are unable to determine whether the variable 'lung disease' includes chronic conditions such as asthma and Chronic Obstructive Pulmonary Disease. As a result of this, our results are applicable to general conditions rather than specific comorbidities listed in the official ICD list. Another limitation is the large number of records with 'information not provided' for comorbidities and symptoms in particular. These records were excluded from the analysis, making the analytical dataset smaller than expected. We also did not have comparative information about persons who tested negative for SARS-Cov-2 and were therefore not able to calculate true risks of hospitalization and death. Testing rates have fluctuated significantly during the pandemic because of factors related to test availability, variations in turnaround times, media and public health messaging, perceived risks as well as testing requirements for certain purposes. This, in turn, has impacted the number of persons testing positive and ultimately the results that we highlight in relation to trends over time. Finally, SARS-CoV-2 testing has been shown to be biased, with certain population groups including Black and African Americans being more likely to test for infection than others (2,11,27–29). Demographic variations in test-seeking behavior could have impacted our results by introducing a proportionally higher case rate and an artificially inflated odds of hospitalization or death among this population group.

In conclusion, we present the first cohort analysis of persons who have tested positive for SARS-CoV-2 infection in the tri-county area surrounding Oklahoma City. We show that in this part of the US, comorbidities and age are significant predictors of a severe outcome of SARS-CoV-2 infection and that the odds of being hospitalized or dying increases with age and number of comorbidities. Our study also includes novel considerations of initial symptoms and concludes that breathing difficulties in particular can lead to an increased likelihood of hospitalization and death. Because this study has analyzed all persons who tested positive for infection, regardless of their hospitalization status, we are able to make these conclusions which apply to a broader part of the population and especially the more diverse urban areas across the United States South-Central plains.

Authorship contribution statement

KGK and AW designed the project. KGK, KA, KB and AW conducted the analysis and wrote the manuscript. KK, KA, BA, EW and PM provided, processed and interpreted data. All authors interpreted the analysis results and revised the manuscript.

Declaration of Competing Interest

The authors have no conflicts of interest to declare.

Funding

This work was funded by the City of Oklahoma City through the Oklahoma City County Health Department.

Disclosures

The authors declare no conflicts of interest.

Acknowledgements

We are grateful for the support of the Oklahoma City County Health Department for providing access to and interpretation of data. We also thank Blaine Boding and Jessica Beetch for their general contributions to the study.

References

1. Ritchie H, Mathieu E, Rodés-Guirao L, Appel C, Giattino C, Ortiz-Ospina E, et al. Coronavirus Pandemic (COVID-19). Our World Data [Internet]. 2020 Mar 5 [cited 2021 Sep 21]; Available from: https://ourworldindata.org/covid-cases

2. Rentsch CT, Kidwai-Khan F, Tate JP, Park LS, King JT, Skanderson M, et al. Patterns of COVID-19 testing and mortality by race and ethnicity among United States veterans: A nationwide cohort study. PLoS Med. 2020 Sep;17(9):e1003379.

3. Harrison SL, Fazio-Eynullayeva E, Lane DA, Underhill P, Lip GYH. Comorbidities associated with mortality in 31,461 adults with COVID-19 in the United States: A federated electronic medical record analysis. PLoS Med. 2020 Sep;17(9):e1003321.

4. Yehia BR, Winegar A, Fogel R, Fakih M, Ottenbacher A, Jesser C, et al. Association of Race With Mortality Among Patients Hospitalized With Coronavirus Disease 2019 (COVID-19) at 92 US Hospitals. JAMA Netw Open. 2020 Aug 3;3(8):e2018039.

5. Almonte M, Au XY, Ali M, Rajabalee N, Hasan S, Shibre T, et al. Association Between COVID-19 Outcomes and Patient Characteristics: A Study in an Inner-City Community Hospital. Cureus. 2021 Aug;13(8):e17255.

6. Bernet P. COVID-19 Infections and Mortality in Florida Counties: Roles of Race, Ethnicity, Segregation, and 2020 Election Results. J Racial Ethn Health Disparities. 2021 Sep 17;

7. Khose S, Moore JX, Wang HE. Epidemiology of the 2020 Pandemic of COVID-19 in the State of Texas: The First Month of Community Spread. J Community Health. 2020 Aug;45(4):696–701.

8. Marcello RK, Dolle J, Grami S, Adule R, Li Z, Tatem K, et al. Characteristics and outcomes of COVID-19 patients in New York City’s public hospital system. PLOS ONE. 2020 Dec 17;15(12):e0243027.

9. Ojinnaka CO, Adepoju OE, Burgess AV, Woodard L. Factors Associated with COVID-Related Mortality: the Case of Texas. J Racial Ethn Health Disparities [Internet]. 2020 Nov 9 [cited 2021 Sep 21]; Available from: https://doi.org/10.1007/s40615-020-00913-5

10. Tai DBG, Shah A, Doubeni CA, Sia IG, Wieland ML. The Disproportionate Impact of COVID-19 on Racial and Ethnic Minorities in the United States. Clin Infect Dis. 2021 Feb 15;72(4):703–6.

11. Ferguson JM, Abdel Magid HS, Purnell AL, Kiang MV, Osborne TF. Differences in COVID-19 Testing and Test Positivity Among Veterans, United States, 2020. Public Health Rep. 2021 Jul 1;136(4):483–92.

12. Jin J-M, Bai P, He W, Wu F, Liu X-F, Han D-M, et al. Gender Differences in Patients With COVID-19: Focus on Severity and Mortality. Front Public Health [Internet]. 2020 [cited 2022 Mar 3];8. Available from: https://www.frontiersin.org/article/10.3389/fpubh.2020.00152

13. Bwire GM. Coronavirus: Why Men are More Vulnerable to Covid-19 Than Women? Sn Compr Clin Med. 2020;2(7):874–6.

14. Zheng Z, Peng F, Xu B, Zhao J, Liu H, Peng J, et al. Risk factors of critical & mortal COVID-19 cases: A systematic literature review and meta-analysis. J Infect. 2020 Aug;81(2):e16–25.

15. Pijls BG, Jolani S, Atherley A, Derckx RT, Dijkstra JIR, Franssen GHL, et al. Demographic risk factors for COVID-19 infection, severity, ICU admission and death: a meta-analysis of 59 studies. BMJ Open. 2021 Jan 1;11(1):e044640.

16. COVID-19 (340) [Internet]. COVID-19. [cited 2021 Sep 22]. Available from: https://oklahoma.gov/covid19.html

17. U.S. Census Bureau QuickFacts: Oklahoma City city, Oklahoma [Internet]. [cited 2022 Mar 3]. Available from: https://www.census.gov/quickfacts/oklahomacitycityoklahoma

18. The Data [Internet]. The COVID Tracking Project. [cited 2021 Apr 30]. Available from: https://covidtracking.com/data

19. Bhaskaran K, Bacon S, Evans SJ, Bates CJ, Rentsch CT, MacKenna B, et al. Factors associated with deaths due to COVID-19 versus other causes: population-based cohort analysis of UK primary care data and linked national death registrations within the OpenSAFELY platform. Lancet Reg Health – Eur [Internet]. 2021 Jul 1 [cited 2021 Sep 22];6. Available from: https://www.thelancet.com/journals/lanepe/article/PIIS2666-7762(21)00086-7/fulltext

20. Zhang Y-J, Sun X-F, Xie B, Feng W-J, Han S-L. Exploration of severe Covid-19 associated risk factor in China: meta-analysis of current evidence. Int J Clin Pract. 2021 Sep 21;e14900.

21. Nuertey BD, Ekremet K, Haidallah A-R, Mumuni K, Addai J, Attibu RIE, et al. Performance of COVID-19 associated symptoms and temperature checking as a screening tool for SARS-CoV-2 infection. PloS One. 2021;16(9):e0257450.

22. Sharma AG, Kumar V, Sodani R, Sapre A, Singh P, Saha A, et al. Predictors of mortality in children admitted with SARS-CoV-2 infection in tertiary care hospital in North India. J Paediatr Child Health. 2021 Sep 21;

23. Larsen JR, Martin MR, Martin JD, Kuhn P, Hicks JB. Modeling the Onset of Symptoms of COVID-19. Front Public Health. 2020;8:473.

24. Nikolai LA, Meyer CG, Kremsner PG, Velavan TP. Asymptomatic SARS Coronavirus 2 infection: Invisible yet invincible. Int J Infect Dis. 2020 Nov 1;100:112–6.

25. Sudre CH, Keshet A, Graham MS, Joshi AD, Shilo S, Rossman H, et al. Anosmia, ageusia, and other COVID-19-like symptoms in association with a positive SARS-CoV-2 test, across six

national digital surveillance platforms: an observational study. Lancet Digit Health. 2021 Sep 1;3(9):e577–86.

26. Loomba RS, Aggarwal G, Aggarwal S, Flores S, Villarreal EG, Farias JS, et al. Disparities in case frequency and mortality of coronavirus disease 2019 (COVID-19) among various states in the United States. Ann Med. 2021 Dec;53(1):151–9.

27. Ballering AV, Oertelt-Prigione S, Olde Hartman TC, Rosmalen JGM, Lifelines Corona Research Initiative. Sex and Gender-Related Differences in COVID-19 Diagnoses and SARS-CoV-2 Testing Practices During the First Wave of the Pandemic: The Dutch Lifelines COVID-19 Cohort Study. J Womens Health 2002. 2021 Sep 1;

28. Dalva-Baird NP, Alobuia WM, Bendavid E, Bhattacharya J. Racial and ethnic inequities in the early distribution of U.S. COVID-19 testing sites and mortality. Eur J Clin Invest. 2021 Aug 14;e13669.

29. Riou J, Panczak R, Althaus CL, Junker C, Perisa D, Schneider K, et al. Socioeconomic position and the COVID-19 care cascade from testing to mortality in Switzerland: a population-based analysis. Lancet Public Health. 2021 Sep 1;6(9):e683–91.

Table 1. Characteristics, hospitalizations and deaths for persons reported with a SARS-CoV-2 infection in the Oklahoma City tri-county area, March 2020-February 2021

Characteristic	Number (%)	Hospitalizations (%)*	Deaths (%)*	Odds of hospitalization, OR (95% CI, p)	Odds of death, OR (95% CI, p)
Overall	**124,925**	**4,076 (3.2)**	**1,858 (1.5)**	-	-
Sex					
Male	59,128 (47.3)	2,138 (52.5)	1,052 (56.6)	1.6 (1.2-1.8, <0.001)	1.5 (1.2-1.8, <0.001)
Female	65,797 (52.7)	1,938 (47.5)	806 (43.4)	Reference	Reference
Age group					
0-5	2,684 (2.1)	19 (0.5)	1 (0.05)	1.0 (0.6-1.9, 0.968)	1.9 (0.2-15.5, 0.548)
5-18	14,446 (11.6)	41 (1.0)	0 (0)	0.9 (0.6-1.3, 0.467)	*(empty)*
18-29	29,842 (23.9)	106 (2.6)	6 (0.3)	Reference	Reference
30-39	21,824 (17.5)	263 (6.5)	30 (1.6)	3.8 (2.8-5.1, <0.001)	6.8 (2.8-16.4,<0.001)
40-49	19,071 (15.3)	446 (10.9)	69 (3.7)	10.7 (7.7-14.9, <0.001)	18.0 (17.8-41.4, <0.001)
50-59	15,703 (12.6)	681 (16.7)	177 (9.5)	13.8 (10.1-19.0, <0.001)	56.3 (25.0-127, <0.001)
60-69	11,389 (9.1)	831 (20.4)	322 (17.3)	12.9 (9.6-17.4, <0.001)	146 (65.2-328, <0.001))
70-79	6,239 (5.0)	948 (23.3)	480 (25.8)	15.4 (11.4-20.9, <0.001)	398 (178-893, <0.001)
80-89	2,846 (2.3)	557 (13.7)	530 (28.5)	11.9 (8.7-16.5, <0.001)	998 (445-2236, <0.001)
90-99	834 (0.7)	182 (4.5)	235 (12.6)	9.2 (6.1-14.0, <0.001)	1603 (708-3629, <0.001)
100+	38 (0.03)	2 (0.05)	8 (0.4)	1.1 (0.6-2.1, 0.655)	1272 (396-4085, <0.001)
No information provided	9 (0.0)	0 (0)	0 (0)	-	-
Ethnic group					
White	45,854 (36.7)	2,715 (66.6)	1,243 (66.9)	Reference	Reference
Hispanic or Latino	15,580 (12.5)	553 (13.6)	152 (8.2)	0.8 (0.6-2.4, 0.467)	1.5 (1.3-6.1, <0.001)
Black or African American	11,012 (8.8)	616 (15.1)	184 (9.9)	2.9 (1.1-5.6, <0.05)	1.4 (1.2-4.5, <0.001)
American/Alaskan Native	4,333 (3.5)	192 (4.7)	6 (0.3)	0.9 (0.8-3.1, 0.504)	0.9 (0.7-1.1, 0.440)
No information provided	48,146 (38.5)	0 (0)	273 (14.7)	-	-
Comorbidities					
No comorbidities	34,373 (27.5)	558 (13.7)	1,043 (56.1)	Reference	Reference
Cardiac disease	6,898 (5.5)	1,140 (28.0)	534 (28.7)	1.9 (1.2-2.7, <0.001)	7.4 (5.9-9.2, <0.001)
Diabetes	5,108 (4.1)	826 (20.3)	327 (17.6)	1.7 (1.3-2.2, <0.001)	2.4 (1.9-3.0, <0.001)
Lung disease	5,081 (4.1)	525 (12.9)	212 (11.4)	1.6 (1.2-2.2, <0.001)	1.8 (1.4-2.3, <0.001)
Kidney disease	1,030 (0.8)	293 (7.2)	105 (5.7)	1.4 (1.0-2.0, <0.05)	5.6 (4.2-7.3, <0.001)
Liver disease	580 (0.5)	71 (1.7)	30 (1.6)	1.1 (0.7-1.5, 0.067)	1.1 (0.6-1.8, 0.814)
Two comorbidities	2,317 (1.9)	335 (8.2)	116 (6.2)	2.2 (1.6-2.9, <0.001)	20.6 15.5-27.3, (<0.001)
Three comorbidities	526 (0.4)	146 (3.6)	59 (3.2)	2.6 (1.6-4.2, <0.001)	49.2 (34.8-69.4, <0.001)
Four or five comorbidities	90 (0.1)	32 (0.8)	19 (1.0)	3.1 (1.1-10.5, <0.05)	136.4 (26.1-712, 0.001)
No information provided	71,855 (57.5)	-	-	-	-

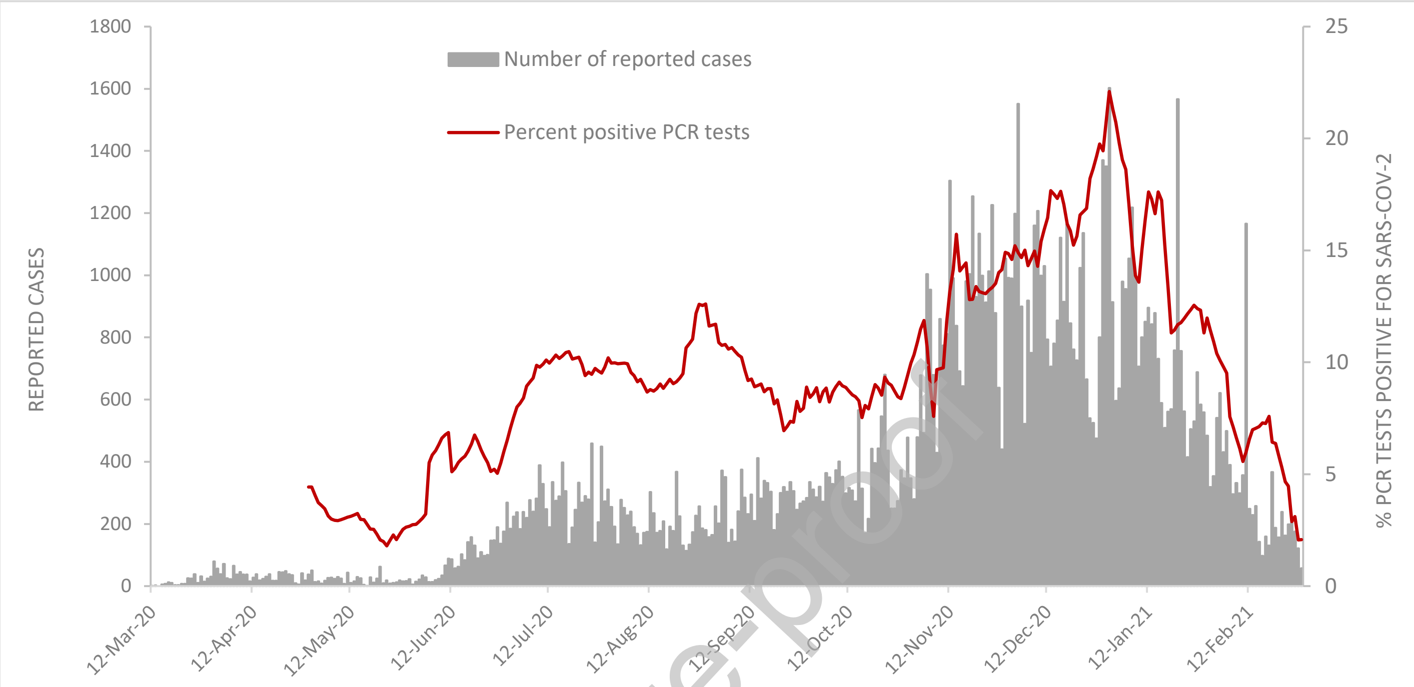
Smoking					
Never smoked	37,832 (30.3)	1,167 (28.6)	247 (13.3)	Reference	Reference
Current/previous smoker	10,485 (8.4)	485 (11.9)	155 (8.3)	3.9 (2.7-5.8, <0.001)	1.6 (1.1-2.6, <0.001)
No information provided	76,608 (61.3)	2,424 (59.5)	1,456 (78.4)	-	-
Symptoms					
Asymptomatic+	73,603 (58.9)	1,463 (35.9)	986 (53.1)	Reference	Reference
Malaise/myalgia	59,189 (47.4)	2,561 (62.2)	550 (29.6)	2.6 (2.1-2.9, <0.001)	0.9 (0.4-1.2, 0.08)
Fever/chills	46,284 (37.0)	2,559 (62.8)	598 (32.2)	2.6 (1.8-2.8, <0.001)	1.4 (1.1-1.8, <0.01)
Gastrointestinal complaints-	41,678 (33.4)	3,588 (88.0)	507 (27.3)	1.6 (1.2-2.0, <0.01)	1.2 (0.9-1.5, 0.621)
Headache	33,596 (26.7)	927 (22.7)	107 (5.8)	1.2 (0.9-1.6, 0.249)	0.2 (0.1-0.3, <0.001)
Cough	29,276 (23.4)	1,590 (39.0)	421 (22.7)	2.5 (1.9-3.4, <0.001)	2.3 (1.9-2.8, <0.001)
Runny nose	21,658 (17.3)	481 (11.8)	93 (5.0)	0.8 (0.6-1.1, 0.156)	0.5 (0.3-0.7, <0.001)
Breathing difficulties	19,779 (15.8)	2,233 (54.8)	642 (34.6)	5.7 (4.8-6.1, <0.001)	9.8 (7.9-10.9, <0.001)
Sore throat	18,832 (15.1)	502 (12.3)	79 (4.3)	1.0 (0.8-1.4, 0.788)	0.5 (0.3-0.6, 0.001)
Anorexia	16,081 (12.9)	900 (22.1)	171 (9.2)	1.8 (1.3-2.4, <0.001)	1.5 (1.2-1.9, <0.001)
Chest pain	9,640 (7.7)	616 (15.1)	94 (5.1)	1.8 (1.3-2.5, <0.01)	1.4 (1.1-1.7, <0.05)
Loss of taste and smell	551 (0.4)	26 (0.6)	1 (0.1)	1.1 (0.3-3.6, 0.902)	0.1 (0.1-0.7, <0.05)
One symptom only	4,679 (3.7)	296 (7.3)	207 (11.1)	1.9 (1.5-2.6, <0.001)	1.3 (1.1-1.5, <0.05)
2-4 symptoms	16,104 (12.9)	936 (23.0)	440 (23.7)	3.9 (2.7-5.8, <0.001)	1.1 (0.9-1.3, 0.354)
5-7 symptoms	14,936 (12.0)	601 14.7)	129 (6.9)	5.1 (3.2-7.8, <0.001)	0.5 (0.2-1.5, 0.234)
8+ symptoms	15,926 (12.7)	780 (19.2)	96 (5.1)	10.9 (3.8-34.2,<0.01)	0.5 (0.1-3.7, 0.522)
No information provided	7,496 (6.0)	-	-	-	-
Occupation (over 18s only)					
Retired	3,434 (2.7)	129 (3.2)	71 (3.8)	1.3 (0.8-2.3, 0.262)	1.4 (1.1-1.8, <0.01)
Unemployed	2,420 (1.9)	90 (2.2)	48 (2.6)	Reference	Reference
Healthcare worker	2,398 (1.9)	92 (2.3)	19 (1.0)	1.4 (0.8-2.3, 0.256)	1.3 (0.9-1.8, 0.134)
Food worker	1,528 (1.2)	67 (1.6)	22 (1.2)	1.4 (0.8-2.3, 0.258)	0.8 (0.5-1.2, 0.225)
Student (college/university)	1,466 (1.2)	54 (1.3)	13 (0.7)	0.8 (0.6-1.2, 0.307)	0.4 (0.2-0.7, <0.001)
Teacher	1,245 (1.0)	41 (1.0)	35 (1.9)	0.7 (0.4-1.4, 0.339)	1.7 (1.2-2.3, <0.01)
No information provided	105,078 (84.1)	-	-	-	-

* percentages refer to the percentage of persons who were hospitalized or died who had the specific characteristic (in some cases this does not add up to 100%), + patient specifically indicated being asymptomatic, - abdominal pain, vomiting, nausea and/or diarrhea

Table 2. Risk factors for hospitalization and death identified using multivariate regression among persons testing positive for SARS-CoV-2 in the Oklahoma City tri-county area, March 2020-February 2021

	Hospitalizations			**Deaths**	
Characteristic	**OR**	**95% CI (p)**	**Characteristic**	**OR**	**95% CI (p)**
Male	1.7	1.1-2.1 (<0.05)	Black or African American	2.1	1.7-2.7 (<0.05)
White	1.9	1.1-3.1 (<0.05)	Cough	2.3	1.1-2.7 (<0.05)
Black or African American	3.2	1.2-6.3 (<0.001)	Fever/chills	1.8	1.3-2.3 (<0.001)
Breathing difficulties	4.0	2.7-5.7 (<0.001)	Kidney disease	4.3	2.9-6.1 (<0.001)
Cough	2.4	1.7-3.5 (<0.001)	Diabetes	2.8	1.4-2.4 (<0.001)
Diabetes	2.4	1.9-3.7 (<0.01)	Aged 70-79	1.6	1.1-2.2 (<0.05)
Aged 50-59	4.0	1.1-16.7 (<0.05)	Aged 80-89	1.9	1.4-2.5 (<0.05)
Aged 60-69	4.1	1.1-15.7 (<0.05)	Aged 90-99	2.9	1.8-3.1 (<0.05)
Aged 70-79	4.8	1.3-18.2 (<0.05)			
Aged 80-89	7.1	1.7-29.0 (<0.01)			
Aged 90-99	7.4	1.1-51.9 (<0.05)			

Figure 1. Notified cases of SARS-CoV-2 infection and PCR test positivity*, Oklahoma City tri-county area 2020-2021



* PCR test positivity reflects 7-day moving average of percentages for Oklahoma State as a whole

Figure 2. COVID-19 case-hospitalization and case-fatality rates, Oklahoma City 2020-2021